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TELEGRAPH REPEATER

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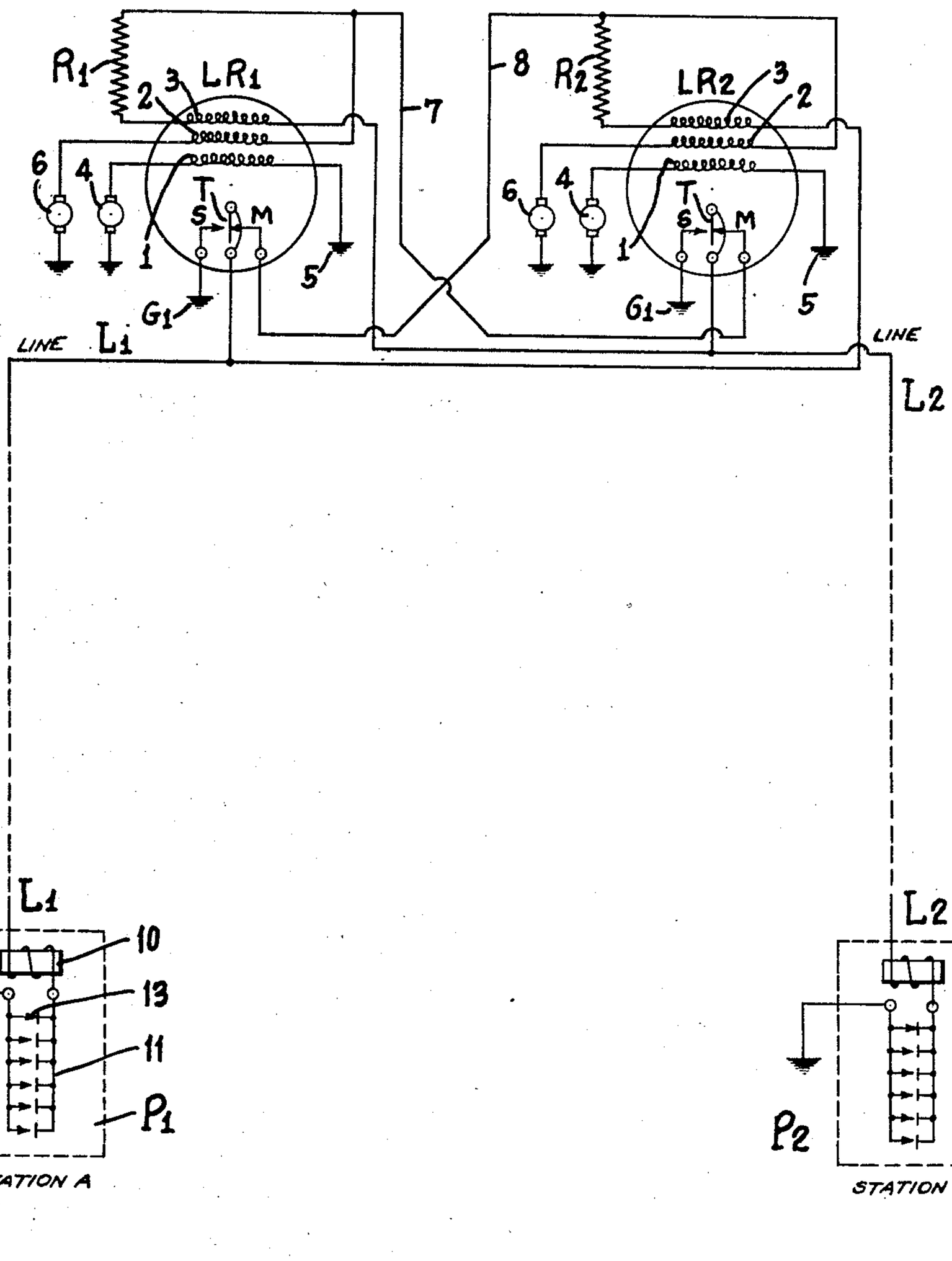

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TELEGRAPH REPEATER

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This invention relates to a telegraph system and more particularly to a repeater of the single line or duplex half repeater type. It is especially advantageous in connection with telegraph systems having large electrostatic capacity and employing machine transmitting and receiving apparatus operating at a high speed, although it is not limited thereto.

In printing telegraph systems as commonly employed, the signals are transmitted in accordance with a five or six unit code composed of combination of marking and spacing impulses. The signals may be transmitted through the keyboard of a printing machine or by a tape transmitter or other form of storage transmitter and the spacing and marking impulses comprising each signal train are transmitted at a predetermined speed and are of substantially equal duration. The printing mechanism operates in synchronism with the transmitting apparatus and responds to each signal combination to effect the printing of a particular character.

The speed of operation of such machines requires the transmission of the individual impulses at a higher frequency than ordinarily employed for manual signalling, and at such speeds only a limited and definite time is available for the marking and spacing impulses to accomplish their function. Any distortion of the signals, such as the lapping over of a marking signal into the period allotted to a spacing signal, or the shortening of either spacing or marking signals, or an out-of-phase condition thereof, may cause the improper operation of the printing mechanism.

However, in a single line circuit the speed of transmission of telegraph signals over lines having considerable electrostatic capacity is limited, because of the time occupied in charging and discharging the line. During the time the line circuit is closed and potential is applied thereto at the transmitting station, for transmitting a marking signal, the line accumulates an electrostatic charge, thus delaying the building up of the operating current at the receiving apparatus. Similarly, upon opening of the line at the transmitting station, to transmit a spacing signal, the charge previously accumulated on the line must discharge through the receiving end thereof, and consequently, the flow of operating current through the receiving apparatus is prolonged. In lines having large capacity, the time required to discharge the line to the potential of the receiving terminal or down to the operating level of the receiving apparatus, may extend the previous marking signal over into the spacing interval so as to considerably lengthen the marking signals and correspondingly shorten the spacing signals.

Assuming the line to be of uniform capacity, the electrostatic charge along the line during the time that potential is applied at one end thereof is not uniform but is directly proportional to the voltage at each particular point and, therefore, in a line having the potential applied at the transmitting end, the charge is very much greater at such end than at the receiving end. As a consequence, a longer time is required to discharge the line through the receiving end than would be required if the line were uniformly charged.

This effect of capacity on telegraph circuits has long been appreciated, particularly in submarine telegraph cables, and it has been the practice, therefore, to ground the cable at the transmitting end for a brief interval between signals to permit the line, at the place where the charge is maximum, to discharge quickly in the direction of the transmitting end, in order to reduce the effect of the discharge current on the receiving apparatus.

It is one of the objects of the present invention to apply this principle to single line and duplex half repeaters and to provide a repeater for use with a single line circuit in which the opposite ends of the outgoing line will be subjected to the same potential at the commencement of a spacing signal, and the line thus discharged mainly through the transmitting end. The discharge current, therefore, is diverted away from the receiving instrument to a large extent and the rate

of discharge of the line to the operating level of the receiving apparatus is increased.

Another object is to provide, in a single line or duplex-half repeater, an improved locking arrangement for preventing the repetition of spacing signals back over the line from which they are being received.

Other objects and advantages of the invention will appear from the following description taken in connection with the accompanying drawings and appended claims.

In accordance with my invention I provide a telegraph repeater, either of the single line or duplex-half repeater type, utilizing either a single current or biased polar relay in the single line circuit, the relay having an operating and a locking winding. The circuit for the operating winding, when marking signals are being transmitted, is completed from a source of current to the outgoing line through the tongue and marking contact of the opposite line relay, the distant end of the line being grounded or connected to a source of definite potential. The locking winding of the relay is short circuited at this time through the tongue and marking contact of the opposite line relay. The arrangement of the relay windings is such that when the tongue of one relay leaves its marking contact, in response to a spacing signal, the circuit including the operating winding of the other relay is completed through the locking winding thereof, in a marking direction and thence directly to the outgoing line, the resistance of this circuit being sufficiently high to effect an initial reduction in the outgoing line current at the beginning of the spacing signal, that is, during the travel time of the relay tongue to its spacing contact, and upon engagement of the relay tongue with its spacing contact, the locking circuit is completed through the spacing contact directly to ground or to a source of definite potential. The spacing contact at the same time applies to the outgoing line, a source of potential of the same polarity and magnitude as that applied at the opposite end of the line. Preferably, I ground each end of the outgoing line.

Since the opposite ends of the line at this time are at the same potential and form part of a closed circuit, the line discharges rapidly from electrostatic effects and mainly in the direction of the transmitting end thereof. The spacing signal is therefore repeated, of substantially full duration and the outgoing line is placed in a discharged condition to respond quickly to the succeeding marking signal.

In order that the invention may be more fully understood, reference will be had to the accompanying drawings in which the single figure is a circuit diagram of a single line repeater embodying my invention.

In the drawing, I have shown a repeater comprising a polarized line relay LR_1 and a polarized line relay LR_2, each having a biasing winding 1, an operating winding 2, and a locking winding 3. The biasing windings 1 each have a grounded source of current 4, such as a generator, connected to one terminal thereof, the opposite terminal being grounded at 5, the polarity of the current source 4 being such as to bias the tongues T of the relays towards their spacing contacts S. One terminal of each of the operating windings 2, is also connected to a grounded source of current 6, the opposite terminal of the winding of relay LR_1 being connected by a conductor 7 to the marking contact M of relay LR_2. The corresponding terminal of the winding 2 of relay LR_2 is connected by a conductor 8 to the marking contact of relay LR_1. The locking winding 3 of relay LR_1 has one terminal connected, through the resistance R_1, to one end of the operating winding 2, the opposite terminal of the locking winding being connected to the tongue T of relay LR_2. Likewise, the locking winding 3 of relay LR_2 has one terminal connected through the resistance R_2, to the one terminal of the operating winding 2, the opposite end of the locking winding being connected to the tongue of relay LR_1. The spacing contact of each of the relays is grounded at G_1.

The tongue of relay LR_1 is also connected to the outgoing line L_1, which is provided at the distant station A, with a printing apparatus P_1. The printing apparatus may include an operating magnet 10 and a group of transmitting contacts 11, one terminal of the latter being grounded at G_2. The circuit through the transmitting contacts, when the printer is on the receiving end of the line, is completed through the normally closed contact 13.

Similarly, the tongue of the relay LR_2 is connected to the line L_2 which terminates at the distant station B, in a simplex printer P_2.

The operation of the system is as follows: With both printers idle and the contacts 13 closed, a circuit is completed from each of the sources of potential 6 through the operating windings 2 and marking contact and tongue of the opposite relay, to the lines L_1 and L_2, and thence through the contacts of the printing mechanism to the ground. The tongues of each of the relays are thus held on their marking contacts against the biasing effect of the windings 1. If the transmitting contacts 11 of the printer P_1 at station A are opened, to transmit a spacing signal over the line L_1, the current in the operating winding 2 of relay LR_2 falls to zero and the tongue of the relay LR_2 leaves its marking contact, due to the spacing bias produced by the winding 1. The circuit of the operating winding 2 of relay LR_1 is thus broken at the marking contact of relay LR_2 and at the same time the short circuit path

of the locking winding 3 is also broken at the marking contact of relay LR_2. As a consequence, current flows from the source of current 6 to the operating winding 2 of relay LR_1, in a marking direction, resistance R_1 and locking winding 3 in a marking direction, directly to the line L_2. Due to the resistance R_1 the current in the line L_2 is reduced in magnitude. However, since this reduced current flows through the additional windings 3 of relay LR_1, it exerts a sufficient magnetizing force on the relay LR_1 to maintain the tongue of the relay upon its marking contact. At the time the tongue of the relay LR_2 reaches its spacing contact, ground G_1 is applied directly to the locking circuit and at the same time, the ground G_1 is also applied to the line L_2, the line L_2 being thus grounded at both ends rapidly discharges.

It will be understood that in place of grounding each end of the line L_2, a source of current of the same polarity and strength might be applied to each end of the line and the same rapid discharge of the line obtained.

While a single locking winding has been shown for relays LR_1 and LR_2, it is to be understood that a number of locking windings may be employed in addition to the operating winding and the number of turns thereof may be proportioned so that the ampere turns provided when the locking windings are in circuit with the ground G_1 is substantially equal to the ampere turns provided when the operating windings 2 are directly in circuit with the lines L_1 and L_2.

In order that the appended claims may be readily applied to the embodiments of the invention shown, the line L_1 may be considered the incoming line, relay LR_1 being the receiving relay and relay LR_2 the transmitting relay for this line. It is to be understood, however, that the repeater provides for transmission of signals in either direction.

Various modifications and changes in the circuit arrangement may obviously be made without departing from the invention and, therefore, I do not desire to be limited to the exact arrangement illustrated and described except in accordance with the appended claims.

What I claim is:

1. In a signaling system, a line circuit, a receiving relay and a transmitting relay associated therewith, said transmitting relay being in an outgoing line circuit controlled by said receiving relay, means for maintaining a closed circuit through the operating winding of said transmitting relay and said outgoing line when the tongue of said receiving relay is on one of its contacts, means for reducing the current in said outgoing line when said tongue is away from both of its contacts and means for establishing a circuit for the winding of said transmitting relay, independently of said outgoing line and producing a unipotential condition for the opposite ends of said outgoing line when the tongue of said receiving relay is on its other contact.

2. In a signaling system, a line circuit, a receiving relay and a transmitting relay associated therewith, said transmitting relay being in an outgoing line circuit controlled by said receiving relay, means for maintaining a closed circuit through the operating winding of said transmitting relay and said outgoing line when the tongue of said receiving relay is on one of its contacts and means for establishing a circuit for the operating winding of said transmitting relay, independently of said outgoing line and producing a unipotential condition for the opposite ends of said outgoing line when the tongue of said receiving relay is on its other contact.

3. In a signaling system, a line circuit, a receiving relay and a transmitting relay associated therewith, said transmitting relay having a winding disposed in an outgoing line circuit controlled by said receiving relay, means for maintaining a closed circuit through said outging line when the tongue of said receiving relay is on one of its contacts, and means for producing a unipotential condition for the opposite ends of said outgoing line when the tongue of said receiving relay is on its other contact.

4. In a signaling system, a line circuit, a receiving relay and a transmitting relay associated therewith, said transmitting relay having an operating winding and a locking winding, said operating winding being in a normally closed circuit including one contact of said receiving relay and said operating and locking windings being in a separate circuit including the other contact of said receiving relay, the resistance of said second circuit being greater than that of the first circuit, and the windings of said transmitting relay being proportioned so that the ampere turns will be substantially uniform when the tongue of said receiving relay is on either of its contacts.

5. A repeater having an incoming line relay and an outgoing line relay, the incoming line relay repeating to the outgoing line and the outgoing line relay repeating to the incoming line, an operating winding for said outgoing line relay, the circuit for said operating winding being normally closed through the marking contact of the incoming line relay, to the outgoing line, said circuit being completed during the transmission of spacing signals over said incoming line through the spacing contact of said incoming line relay independently of said outgoing line, and said circuit being completed during the time the tongue of said incoming line relay is away from its contacts, directly through the outgoing line.

6. A repeater having an incoming line re-

lay and an outgoing line relay, the incoming line relay repeating to the outgoing line and the outgoing line relay repeating to the incoming line, an operating winding and a locking winding for said outgoing line relay, the circuit for said operating winding being normally completed through the marking contact of the incoming line relay, to the outgoing line, said circuit being completed during the transmission of spacing signals over said incoming line through the locking winding and spacing contact of said incoming line relay independently of the outgoing line, and said circuit being completed during the time the tongue of the incoming line relay is away from its contact, directly through the locking winding and said outgoing line.

7. A telegraph system comprising a repeater having an incoming and an outgoing line associated therewith, a relay for repeating signals transmitting over the incoming line, to the outgoing line, means including the contacts of said relay for maintaining a closed circuit through said outgoing line when marking signals are transmitted over said incoming line, and means acting when spacing signals are transmitted over said incoming line to first reduce the current in said outgoing line and subsequently, to connect both ends of said line to potential of the same magnitude and polarity.

8. A telegraph repeater having an incoming line relay and an outgoing line relay, an operating winding for said outgoing relay, the circuit for said operating winding being completed through the marking contact of said incoming line relay and the outgoing line, when marking signals are transmitted over said incoming line, said circuit being completed through the spacing contact of said incoming line relay when spacing signals are being received, and said circuit being completed to the outgoing line independently of said contacts during the travel time of the tongue of said incoming line relay from one of its contacts to the other.

9. A telegraph repeater having an incoming line relay and an outgoing line relay, an operating and a locking winding for said outgoing line relay, the circuit for said operating winding being completed directly through the outgoing line when marking signals are being transmitted to said incoming line relay, said circuit being completed through said locking winding when the tongue of said incoming line relay is away from its marking contact, and means for connecting the end of said outgoing line, at the repeater, to a potential of the same polarity and magnitude as the distant end of the line, when the tongue of the incoming line relay engages its spacing contact.

In testimony whereof I affix my signature.

CYRUS C. FERGUSON.